

# **Irradiation, Heat, and Corrosion Resistant Cement-Based Coating for Mitigating Aging and Irradiation Effects in Nuclear Power Plants**

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## **Project Vision**

Develop next generation cementitious coating materials to extend the lifetime of key infrastructures subject to extreme conditions.

# Aging of Energy Infrastructure is a Major Challenge

Nuclear Power Plants



Oil and Gas Pipelines



Concurrent Heat,  
corrosion, radiation

Maintenance order of  
billions

Inaccessibility, safety,  
public trust, etc

# Maintenance and Upgrade of Assets Cost the Industry ~\$14B

## Nuclear Power Plants



- The US nuclear industry invests ~\$7.5 bn/yr in maintenance and upgrades of its plants
- Globally ~400 nuclear power plants: US (~99 plants); France (~58), Japan (~50), Russia (33), China (25)
- US is the world's largest producer of nuclear power, +30% of worldwide nuclear generation of electricity

## Oil and Gas Pipelines



- ~\$7 bn/yr corrosion of onshore oil and gas pipelines
- >190k miles of liquid petroleum pipelines and 2.4 million miles of underground pipeline system in the US
- US has the most miles of pipelines than any other country in the world

<sup>1</sup> World Nuclear Association: Nuclear Power in USA. <http://world-nuclear.org/info/Country-Profiles/Countries-T-Z/USA--Nuclear-Power>

<sup>2</sup> National Association of Corrosion Engineers (NACE) Report. s

# What is at stake ?

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How to design a reliable and multifunctional material that can withstand multiple extreme conditions (HT, corrosive environment, radiation, etc) at once?

- New Construction/Replacement?
- Modifying Chemical Pathways ?
- Nanoscience and Nanotechnology ?



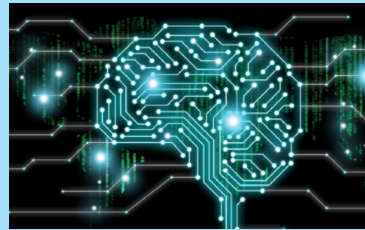
# C-Crete High Performance Coating Material



## Raw Material Producers



## Chemical Manufacturers



## Utilities/Power Plants



## Value Propositions

- ✓ High Temperature, Corrosion, and Radiation Resistant
- ✓ High Strength and Toughness
- ✓ Adhesion to Various Materials (concrete, metal, cables)
- ✓ Ease of Application (it cures in hrs)
- ✓ No Toxicity and Homogenous Mixing
- ✓ In-Situ Application and Ease of Implementation
- ✓ Low Cost

# Project Objectives

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**Overall Objective:** To develop a disruptive coating product composed of cement and nanomaterials that significantly mitigates materials degradation and aging in nuclear plants and enhance their lifetime.

**Phase 1:** Development of the hybrid composite to offer the best hybrid nanostructure, optimum slurry, coating thickness, and strength and adhesion properties.

**Phase II:** Development of a basic prototype that exhibits remarkable resistance to extreme conditions of high temperature, corrosion and radiation.

# Key Result

We have created a coating product using a proprietary formula (made of typical cement and nanomaterials) that exhibits multiple improved properties such as:

Strength

High  
Temperature

Shrinkage

Rheology

Thermal  
Conductivity

Electrical  
Conductivity

Radiation  
Tolerance

Adhesion  
Strength

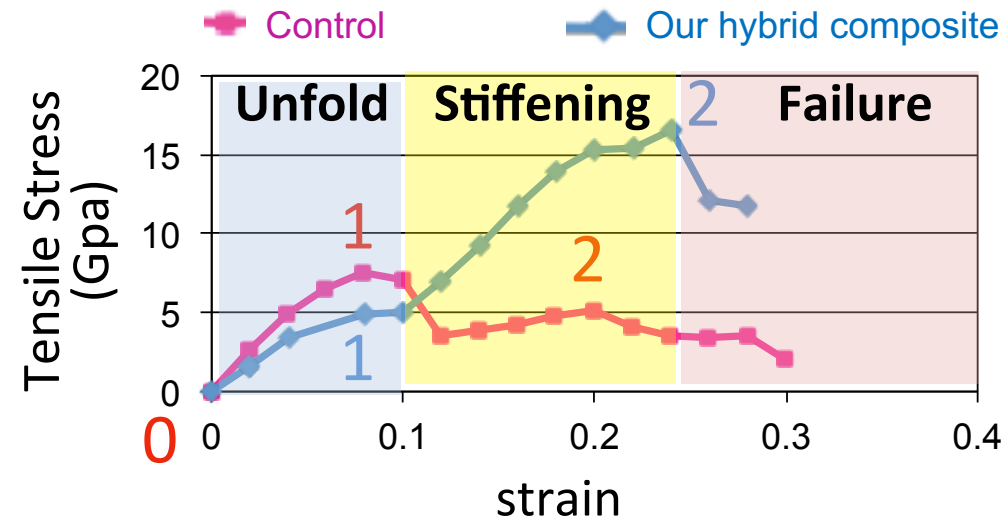
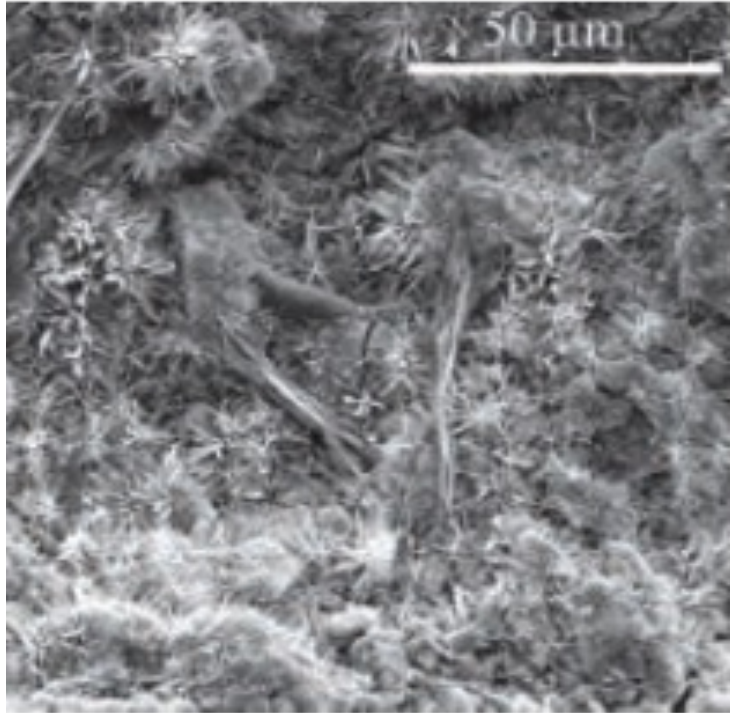
Hydrophobicity

Abrasion  
Resistance

Density

Corrosion

# Representative results



Improved mechanics, heat diffusion, durability, etc



# Challenges and Risks

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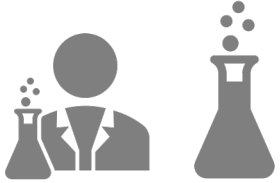
## **Key Risk:**

Penetration and acceptance of a new product in conservative nuclear industry

## **Mitigation Strategies:**

- Partner with established coating/chemical companies
- Ensure meeting all safety codes
- Start with a single extreme condition (e.g. heat)

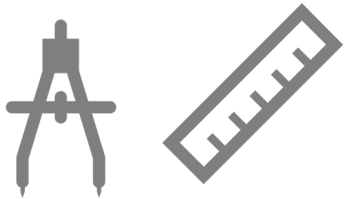
# T2M: Potential Partnerships



Coating/chemical companies with experience in specialty applications



Demonstration of use cases (nuclear, oil and gas, industrial floor applications, etc)



Nuclear industry and Standard test representatives (ASTM D3911, etc)



Application of our technology in different cement (matrix) formulations for broader usage

# Thank you

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Contact us: [info@ccretetech.com](mailto:info@ccretetech.com)

## Open Positions at C-Crete:

- Chemical/Process Engineer
- Mechanical Engineer
- Materials Scientist/Engineer
- Electrical Engineer